

### **REMARKS/ARGUMENTS**

Reconsideration and allowance in view of the foregoing amendment and the following remarks are respectfully requested.

An Information Disclosure Statement was filed on January 23, 2007. Consideration of the documents cited therein and return of an initialed cop of the PTO/SB/08a filed therewith are requested.

Claims 1-2, 8-13, 19-39 and 42 were rejected under 35 USC 103(a) as unpatentable over Matsubara. Applicant respectfully traverses this rejection.

Each of the independent claims has been amended above to recite more particularly that the ignition apparatus claimed has a spark plug that comprises only a single earth electrode, that the single earth electrode has "another" end including a surface formed to face the one end of the center electrode, and that surface has a cylindrical protrusion secured thereon. In other words, the present invention has been realized in a spark plug that has only a single earth electrode. Since there is only one earth electrode, it is possible according to the invention to keep an amount of ignition energy supplied to the spark plug below 17mJ. In this regard, reference is made to the original specification, in particular page 16, lines 13-20, and page 17, lines 8-13, for example.

The instant invention as recited in the above-amended claims is based on the inventors' study of the relationships between the dimensions of both the center electrode and the earth electrode of an ignition (spark) plug and an amount of energy necessary for igniting the fuel-air mixture. The inventors' study lead to finding an amount of energy that should be supplied to a spark plug whose electrodes are made more compact. This saves power consumption and allows the ignition power supply to be more compact. The inventors' discovery also yielded the new limitation that a density of ignition energy is less than 32 W, which is also a new finding based on the inventors' recognition that the energy consumed as cooling loss by the ignition plug electrodes depends on the dimensions of the electrodes. Thus, the present invention

as recited in the amended claims is able to provide the total amount of energy necessary for the electrodes as well as the density of energy necessary therefor.

In contrast, Matsubara teaches a spark plug that has two earth electrodes 11 (See Figs. 2 and 3 thereof) each having a chip secured thereon. Clearly, then, the Matsubara structure is totally different from that claimed in applicant's independent claims. Therefore, in Matsubara, it is impossible to keep an amount of ignition energy supplied to the spark plug below 17 mJ (or a density of ignition energy less than 32W), as long as two earth electrodes are provided, even if the diameter of each of those two chips is set to 2.3 mm or less. The two earth electrodes 11 double the total amount of consumed energy, requiring a larger amount of ignition energy to be supplied; more than the 17 mJ (32 W density) required according to the claimed invention. As a result, in Matsubara, a reduction and consumption of power cannot be realized and the ignition power supply cannot be made more compact.


As noted above, the present invention has been made based on the inventor's own study and findings which are new even to those skilled in the art. That is, the present invention is directed to a spark plug which has a thinner-diameter center electrode and earth electrode and yet is still higher in ignition performance and consumes less energy. It is submitted that a spark plug as claimed herein is not taught or suggested in any of the prior art of record.

All objections and rejections having been addressed, it is respectfully submitted that the present application is now in condition for allowance and an early Notice to that effect is earnestly solicited.

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Respectfully submitted,

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